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Single-centre experience in surgery of acute aortic type A dissection and true aortic arch aneurysm

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Abstract

Background: Surgery of the aortic arch is challenging.

Aim: To assess the results of aortic arch surgery.

Methods: Analysis of 172 patients operated on arch dissection (emergency group: 97 patients) or aneurysm (elective group: 75 patients) between 2007 and 2014. Arch surgery was defined as a procedure requiring circumferential anastomosis at the level of the aortic arch or the descending aorta with the use of techniques of brain protection (deep hypothermic circulatory arrest [DHCA] or selective antegrade cerebral perfusion [SACP]) and/or debranching of at least one supra-aortic vessel.

Results: Men predominated in both groups (> 70%). Men were younger in the emergency group (55 vs. 66 years; $p < 0.008$). The operative risk was higher in the emergency group (19.2% vs. 12.5%; $p < 0.001$). Forty-nine per cent of the patients from the emergency group and 5% from the elective group were operated with antiplatelet therapy ($p < 0.001$). Extended hemiarch procedure was performed in 79% (n = 77) in the emergency and 76% (n = 57) in the elective group. Total arch replacement was performed in 19 (21%) patients from the emergency and 18 (24%) patients from the elective group. In these patients debranching was performed in 68% of the emergency patients group and in 67% of the elective group. Elephant trunk procedure (classic/frozen) was performed in 53% (n = 10) from the emergency and in 78% (n = 14) of patients from the elective group. Aortic valve sparing surgery was performed in 20% of patients from the emergency and 9% from the elective group ($p = 0.063$). DHCA was performed in 58% (n = 43) of patients from the elective group and 39% (n = 37) from the emergency group. SACP was performed in 61% (n = 58) of patients from the emergency and 42% (n = 31) from the elective group. Thirty-day mortality in the emergency group reached 33% (n = 32), and in the elective group 15% (n = 11; $p = 0.007$). In multivariate analysis, predictors of death in the emergency group were: Logistic EuroSCORE above 19.5%, extracorporeal circulation time above 228 min, and postoperative acute renal failure (ARF); and in the elective group: DHCA time above 26 min, rethoracotomy due to bleeding, and ARF. Follow-up was completed in 100% of patients in terms of vital status. The mean follow-up time of the patients from the emergency group was 24.3 ± 27.10 (min 0, max 92) months, and from the elective group 30.3 ± 24.5 (min 0, max 99) months. During the follow-up period all-cause mortality in the emergency group was 43% (n = 42/97), and in the elective group it was 36% (n = 27/75).

Conclusions: Early mortality in the emergency group was higher, while long-term mortality did not differ among the groups. Post-operative ARF is a critical predictor of mortality in both groups.

Key words: aortic aneurysm, aortic arch surgery, acute aortic dissection, protection of central nervous system

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INTRODUCTION

Elective surgery of the aortic arch should be considered in patients who have an aortic arch aneurysm with a diameter ≥ 55 mm or who present symptoms or signs of local compression [1]. Aortic arch surgery may be considered in patients with aortic arch dilatation, who already have an indication for cardiac surgery [1]. Surgical treatment of aortic arch aneurysms with diameter < 50 mm ought to be considered in patients with Marfan's syndrome, family history of rupture, or dissection of the aorta [2, 3]. The indications for emergent aortic arch surgery are: acute aortic dissection located within the arch, aortic rupture, false aneurysm, and impending dissection (penetrating aortic ulcer and intramural haematoma). Development of aortic arch surgery techniques was possible due to improvement of protection and monitoring of the central nervous system (CNS) [4–6].

Deep hypothermic circulatory arrest (DHCA) is a pivotal method of body protection including CNS from ischaemia. Deep hypothermia slows down cellular metabolic processes [7, 8]. With the reduction of body temperature both cellular metabolic activity and oxygen consumption by cells decreases. Since brain tissue is the least resistant to anoxia, new methods have been found to complement DHCA [9]. Retrograde cerebral perfusion and selective antegrade cerebral perfusion (SACP) provide blood flow through CNS during circulatory arrest [5].

METHODS

Patient characteristics and clinical data were collected from a standardised institutional registry on 172 consecutive patients with aortic aneurysm or aortic dissection involving aortic arch operated on in the Department of Cardiac Surgery, University Hospital in Bialystok, Poland between 2007 and 2014.

Arch surgery was defined as a procedure requiring circumferential anastomosis at the level of the aortic arch or the descending aorta with the use of techniques of brain protection (DHCA or SACP) and/or debranching of at least one supra-aortic vessel [6].

Patients were divided into two groups depending on the urgency of surgery. The first group included 97 (56.4%) patients undergoing emergency surgery due to acute aortic dissection type A according to Stanford classification or rupture of aortic arch or supra-aortic vessels. The second group consisted of 75 (43.6%) patients undergoing elective surgery of a true aneurysm within the aortic arch and supra-aortic vessels or a chronic aortic dissection. Preoperative diagnostics and postoperative control tests were based on transthoracic and transoesophageal echocardiography and/or computed tomography angiography of the aorta.

Postoperative evaluation was carried out in an outpatient department or by phone (clinical follow-up was done in 91% of patients). Information on vital status (alive or dead) was obtained through the National Health Fund database. Follow-up was completed in 100% of patients in terms of vital status.

Anaesthesia and perioperative care

All of the patients were operated on through median sternotomy under general endotracheal anaesthesia with extended monitoring. The oesophageal and rectal or bladder temperature was monitored. The pressure in both radial arteries was monitored. Cerebral perfusion was monitored with the use of visualisation of cerebral tissue regional oxygenation based on the module of near-infrared spectroscopy. Local head protection with ice bags was applied. Pharmacological neuroprotection ($MgSO_4$, Lignocaine, Mannitol, Propofol, Thiopental, Methylprednisolone was administered with a continuous drop infusion from the beginning of extracorporeal circulation (ECC) until weaning from ECC.

Extracorporeal circulation

Extracorporeal circulation was conducted with the use of a heart-lung machine (System Stöckert S 3) with air-oxygen mixer (Sechrist Industries, Anaheim, CA, USA), initially using the flow index within the range 2.4–2.8 L/min/m^2 (maintaining mean arterial pressure at a level of approximately 60–70 mm Hg), decreasing it gradually with the reduction of body temperature according to the index 0.1 L/min/m^2/1°C. Oxygenators of type Trillium Affinity NT 541T (Medtronic, Minneapolis, MN, USA) and Compactfo Evo (Sorin, Milan, Italy) were used. Heat exchangers, ice (local heart cooling) and ice bags (local head cooling) were used to lower body temperature. Depending on the operator's decision regarding the method of brain protection, the patient was cooled down to 18–20°C if only DHCA was applied, while with the use of SACP the patient was cooled down to 25°C. Rewarming was conducted with a 10°C gradient to 34°C.

The heart was stopped with cold blood cardioplegia 4:1 administered every 20–30 min. Immediately after the proximal anastomosis (e.g. supracoronary prosthesis of the ascending aorta, Bentall/David procedure) was completed, perfusion of the heart through the cardioplegic line was initiated and conducted during the arch surgery.

Protection of central nervous system

Cerebral protection was achieved by DHCA or a SACP with perfusion of two (innominate and left common carotid) or three (left subclavian) arteries (retrograde coronary sinus perfusion cannulas with 15 Fr manual cuff 94965, DLP, Medtronic, Minneapolis, MN, USA). Volumetric flow rate of cerebral perfusion was maintained at the level of 10 mL/kg/min to obtain the pressure measured on the right and left radial artery within 40–70 mm Hg.

Statistical analysis

Chi-square independence test and accurate Fischer test were used in the statistical analysis to examine the dependencies between qualitative features. Distribution normality was verified with Kołmogorow-Smirnow test and Lillefors tests as well as Shapiro-Wilk test. No distribution normality of

the analysed quantitative variables was observed. Non-parametric U Mann-Whitney test was used for the comparison of quantitative variables without distribution normality in both groups. Data are presented as the median and interquartile range (IQR from the 25th to the 75th percentile). All preoperative, perioperative and postoperative variables were included in analysis looking for predictors of mortality using a multivariate logistic regression model and were expressed as odds ratios with 95% confidence intervals. Survival curves were estimated with the use of Kaplan-Meier method. The differences between survival curves were assessed with the use of the log-rank test.

Statistically significant results were assumed as $p < 0.05$. During the calculations the following software packets were used: Statistica 10.0 by StatSoft and IBM SPSS Statistics 21.0 by Predictive Solutions.

Surgical techniques

The surgical techniques included extended hemiarch and total arch replacement with concomitant procedures. Hemiarch involved resection of the smaller curvature of the aortic arch and open anastomosis during DHCA/SACP. Total arch procedure consisted of a transverse aortic arch replacement with vascular prosthesis either with island technique or debranching of at least one supra-aortic vessel, or a combination of these methods. Depending on the condition of the descending aorta, the distal anastomosis was performed in 'end-to-end' fashion, or as an Elephant Trunk procedure, classic or frozen (E-vita open plus JOTEC, Hechingen, Germany).

Concomitant procedures concerning aortic pathology included: implantation of supracoronary prosthesis, replacement of aortic root with valved conduit with reimplantation of coronary arteries using Bentall de Bono technique, and valve-sparing aortic root replacement operation (David, Yacoub, or Urbanski procedure). As well as aortic pathologies concomitant procedures were performed: mitral, tricuspid valve reconstruction or replacement, aortic valve reconstruction or replacement, coronary artery bypass grafting, radiofrequency ablation of the atrial fibrillation, atrial septal defect and ventricular septal defect closure.

RESULTS

Patients from the emergency group were significantly younger than those from the elective group. Most of the patients in both groups were men. More than 40% of patients undergoing emergency procedures had cardiac tamponade with anuria or oliguria reflected by statistically higher preoperative concentration of creatinine. Twenty two per cent of patients from the emergency group received dual antiplatelet therapy (clopidogrel and aspirin), but no one from elective group did. Forty nine per cent of patients from emergency group received aspirin, compared to only 5% from the elective group, but coronary artery disease was more frequent in the elective group ($p < 0.001$). Surgical risk was high in both groups but significantly higher in the emergency group $p < 0.001$ (Table 1).

Extracorporeal circulation time and aortic cross-clamp time did not differ between the groups. Femoral artery cannulation and right carotid artery were significantly more frequently used in the emergency group, while ascending aorta or arch was used in the elective group. In the elective group the DHCA was used in 58% of the patients with a median time of 21 min. In this group the median body temperature was 20°C. In the emergency group CNS protection was most commonly performed with SACP (61% of patients). Median time of circulatory arrest was 38.5 min including median SACP time of 36.5 min, median temperature was 25°C. No statistically significant differences between the groups in terms of time of circulatory arrest, cerebral perfusion, or body temperature were observed (Table 2).

The primary operative method in both groups was extended hemiarch replacement. The preferred method of total arch replacement was debranching (68% in the emergency group, 67% in the elective group). Elephant Trunk procedure (classic and frozen) was performed in 53% of patients (n = 10/19) from the emergency group and 78% (n = 14/18) from the elective group. Treatment of adjacent ascending aorta consisted mostly of supracoronary aortic replacement 43 (44%) in the emergency group and 32 (43%) in the elective group. Bentall procedure was performed in 32% of patients (n = 31) in the emergency group and in 29 (39%) patients in the elective group. Valve-sparing aortic root replacement surgery (David, Yacoub, Urbanski) was performed in 19 (20%) patients in the emergency group, and seven (9%) in the elective group ($p = 0.063$) (Table 3).

Other concomitant procedures listed in Table 3 were significantly more frequently performed in elective patients. One patient from the emergency group underwent debranching of the brachiocephalic trunk without extracorporeal circulation, due to a post-traumatic false brachiocephalic aneurysm. One high-risk patient from the elective group, with contraindications to ECC, underwent wrapping of the ascending aorta aneurysm, brachiocephalic trunk and the adjacent part of the proximal aortic arch without use of ECC.

Hospital mortality (30 days) was 2-fold higher in the emergency group compared to the elective group ($p = 0.007$) (Table 4). In the emergency group six patients had cardiac arrest before surgery; four of them (67%) died within the first 24 h after surgery. No statistically significant differences between the groups in terms of re-thoracotomy due to postoperative bleeding, neurological incidents, acute renal failure (ARF) requiring renal replacement therapy (RRT), or prolonged respiratory insufficiency requiring tracheostomy were observed (Table 4).

All preoperative, perioperative and postoperative variables were included in the analysis looking for predictors of

Table 1. Baseline characteristics

	Emergency group (n = 97; 56%)	Elective group (n = 75; 44%)	P
Male	71 (73%)	59 (79%)	NS
Age [years], median (IQR)	56 (19)	65 (17)	0.02
Female/male	66 (15)/55 (17)	67.5 (13.5)/66 (17)	NS/0.008
Dual antiplatelet therapy (clopidogrel + aspirin)	21 (22%)	0	< 0.001
Aspirin therapy	47 (49%)	4 (5%)	< 0.001
Arterial hypertension	74 (76%)	57 (76%)	NS
COPD	3 (3%)	4 (5%)	NS
Type 2 diabetes	10 (10%)	13 (17%)	NS
Body mass index, median (IQR)	28.6 (6.3)	27.8 (8.1)	NS
Serum creatinine > 200 μmol/L	13 (13%)	1 (1.3%)	0.005
Coronary artery disease	13 (13%)	28 (37%)	< 0.001
Extracardiac arteriopathy	7 (7%)	12 (16%)	NS
Neurological diseases severely affecting everyday life	8 (8%)	5 (7%)	NS
Cardiac tamponade	40 (41%)	0 (0%)	< 0.001
Ejection fraction > 50%	56 (58%)	41 (55%)	NS
Ejection fraction 30–50%	37 (38%)	32 (42%)	NS
Ejection fraction < 30%	4 (4%)	2 (3%)	NS
REDO	9 (9%)	6 (8%)	NS
Additive EuroSCORE, median (IQR)	9.5 (5.3)	8 (2.3)	< 0.001
Additive EuroSCORE, mean ± SD	10.3 ± 3.1	8.1 ± 2.0	< 0.001
Logistic EuroSCORE, median (IQR)	19.2 (25.8)	12.5 (8.0)	< 0.001
Logistic EuroSCORE, mean ± SD	25.5 ± 17.4	13.7 ± 8.2	< 0.001

COPD — chronic obstructive pulmonary disease; IQR — interquartile range; REDO — reoperation; SD — standard deviation

Table 2. Extracorporeal circulation (ECC) and central nervous system protection

	Emergency group (n = 97)	Elective group (n = 75)	P
ECC time [min], median (IQR)	231.0 (131.3)	279.5 (81.8)	NS
Aortic cross-clamp time [min], median (IQR)	130.0 (65.5)	138.0 (56.5)	NS
Without ECC	2 (2%)	1 (1.3%)	NS
Cannulation site:			
Femoral artery	57 (60%)	29 (39%)	0.007
Right common carotid artery	10 (10.5%)	0	0.003
Left common carotid artery	7 (7.5%)	3 (4%)	NS
Ascending aorta/arch	10 (10.5%)	32 (43%)	< 0.001
Brachiocephalic trunk	8 (8.5%)	8 (11%)	NS
Subclavian artery	3 (3%)	2 (3%)	NS
DHCA	37 (39%)	43 (58%)	NS
DHCA time [min], median (IQR)	18 (11)	21 (7)	NS
Temperature DHCA [°C], median (IQR)	20 (5)	20 (2.5)	NS
SACP	58 (61%)	31 (42%)	NS
DHCA/SACP time [min], median (IQR)	38.5 (48.3)/36.5 (45.5)	41.0 (37.8)/35.0 (26.3)	NS
Temperature DHCA/SACP [°C], median (IQR)	25 (1.8)	25 (3.3)	NS

DHCA — deep hypothermic circulatory arrest; ECC — extracorporeal circulation; IQR — interquartile range; SACP — selective antegrade cerebral perfusion

Table 3. Surgical techniques

	Emergency group (n = 97)	Elective group (n = 75)	P
Hemiarch	77 (79%)	57 (76%)	NS
Arch	19 (21%)	18 (24%)	NS
Debranching	13 (68%)	12 (67%)	NS
Island	9	7	NS
Frozen Elephant Trunk	6	10	NS
TEVAR + debranching	1	0	NS
Classic Elephant Trunk	4	4	NS
Concomitant procedures:			
Supracoronary prosthesis of the ascending aorta	43 (44%)	32 (43%)	NS
Bentall	31 (32%)	29 (39%)	NS
David/Yacoub/Urbanski	5/1/13 (20%)	6/0/1 (9%)	NS. 0.063
Urbanski	13	1	0.004
Aortic valve replacement	4	19	< 0.001
Aortic valve plasty (repair)	1	5	NS
MVP/MVR	0	11	< 0.001
Tricuspid valve plasty (repair)	0	4	0.035
Coronary artery bypass grafting	7	20	0.001
Radiofrequency ablation of the atrial fibrillation	0	6	0.006
Atrial septal defect closure	2	1	NS
Ventricular septal defect closure	1	0	NS

MVP — mitral valve plasty (repair); MVR — mitral valve replacement; TEVAR — thoracic endovascular aortic repair

Table 4. Postoperative complications

	Emergency group (n = 97)	Elective group (n = 75)	P
Hospital death	32 (33%)	11 (15%)	0.007
Rethoracotomy due to bleeding	29 (30%)	16 (21%)	NS
Stroke	11 (11%)	7 (9%)	NS
Acute renal failure requiring renal replacement therapy	17 (17%)	9 (12%)	NS
Tracheostomy (prolonged respiratory insufficiency)	4 (4%)	4 (5%)	NS

mortality. The results are presented in Tables 5 and 6. Significant predictors of mortality in the emergency group were: Logistic EuroSCORE above 19.5%, ECC time above 228 min, and postoperative ARF requiring RRT. In the elective group: increasing DHCA time above 26 min, incidences of postoperative re-thoracotomy due to bleeding, and ARF requiring RRT were found to be significant predictors of mortality.

The mean follow-up time of the patients from the emergency group was 24.3 ± 27.10 (min 0, max 92) months, and from the elective group 30.3 ± 24.5 (min 0, max 99) months. In the emergency group the survival curve shows the highest mortality in the immediate postoperative period (30-days mortality rate: 33%, n = 32/97), then stabilise at the same level (approximately 60% during the following eight years). In the elective group the highest mortality was in the early postoperative period, but it was 2-fold lower in comparison to the emergency group (30-day mortality rate: 15%, n = 11/75). After that the survival gradually decreases. During the first four years following the surgery, in the elective group the survival rate is higher, but not significantly (test log rank, p = 0.2216) (Fig. 1). After four years the curves meet and further observations showed better outcome in

Table 5. Predictors of death in emergency group, multivariate logistic regression model

Predictors of death in emergency group	Odds ratio	95% confidence interval	P
Logistic EuroSCORE [%] > 19.5	6.75	2.68–17.02	< 0.001
Extracorporeal circulation time [min] > 228	3.77	1.60–8.88	0.002
Acute renal failure requiring renal replacement therapy	8.67	2.29–32.73	< 0.001

Table 6. Predictors of death in elective group, multivariate logistic regression model

Predictors of death in elective group	Odds ratio	95% confidence interval	P
Deep hypothermic circulatory arrest time [min] > 26	4.12	1.44–11.75	0.008
Re-thoracotomy due to bleeding	5.90	1.80–19.28	0.003
Acute renal failure requiring renal replacement therapy	27.2	3.15–235.1	< 0.001

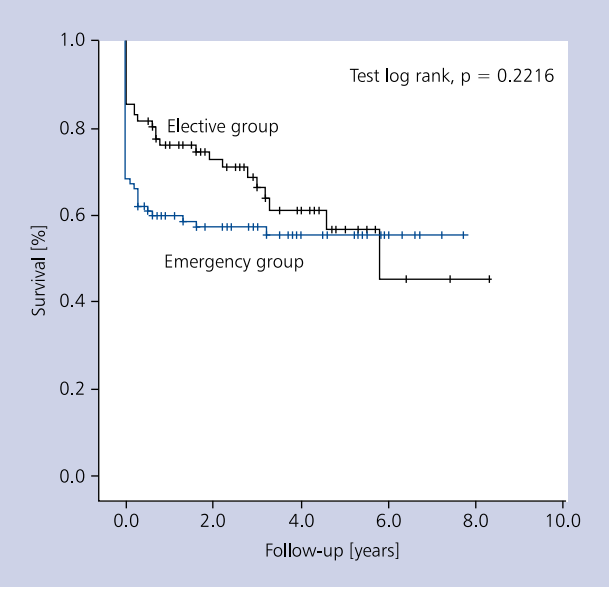

Figure 1. Kaplan-Meier survival curve for patients undergoing aortic arch surgery

the emergency group, but also not significant. The constant decrease in the elective group's survival curve may be related to significantly older age in this group ($p < 0.02$). During the follow-up period all-cause mortality in the emergency group was 43% (n = 42/97), and in the elective group it was 36% (n = 27/75).

DISCUSSION

In our material, based on 172 patients operated on due to dissection or true aneurysm of aortic arch between 2007 and 2014, the operative risk estimated by additive EuroSCORE reached a mean value of 10 ± 3. Colleagues from Leipzig (Germany) [10] examined 600 patients who underwent aortic arch surgery in over a seven-year period. The mean operative risk estimated by additive EuroSCORE was 10 ± 3 [10]. Additionally, they found that only 37% of their cases were acute type-A dissections, while in our material this number reached 56.4%.

The patients undergoing emergency surgeries were statistically significantly younger compared to the elective group. This may in part explain the better long-term survival in the emergency group. Other reports confirm that men aged between 55 and 60 years are prevalent to incidence of acute aortic dissection type A or aortic trauma [2, 11].

Femoral artery cannulation was preferred in the emergency group, while ascending aorta was preferred in the elective group. The choice of the optimal arterial cannulation site is a subject of debate. The guidelines suggest axillary artery access as the first choice for surgery of the aortic arch and aortic dissection [1]. Immer et al. [12] showed a significantly better neurological outcome for patients undergoing cerebral perfusion through the right axillary artery compared with selective antegrade perfusion. Over the last few years, the Leipzig group have used routinely axillary access for arch surgery and they have not found any effect of the cannulation site on neurological or other perioperative outcome [10]. Patris et al. [13] proved that the femoral artery remains a bailout option in an emergency situation. Rylski et al. [14] published a great deal of discussion about the best cannulation site in patients with acute type A aortic dissection (AAAD) [14]. The authors claim that all proposed cannulation sites are proven to be safe and efficacious in AAAD patients with dissected supra-aortic vessels. There are no randomised data concerning of the cannulation site in AAAD.

The most frequent surgical technique in both groups was extended hemiarch (over 75%). More than 20% of patients in both groups underwent complex procedures of a complete transverse aortic arch replacement. In our data, the most common treatment of the aneurysm of the ascending aorta was implantation of a supracoronary prosthesis, and for aortic valve disease coexisting with aortic arch aneurysm it was the Bentall procedure. Similar data were presented in the German Registry of Acute Aortic Dissections, which included over 2000 patients [15].

In our material, stroke was observed in 11% of patients in the emergency group and 9% in the elective group. This corresponds with the report from Leipzig, in which Misfeld et al. [10] observed 11% of neurological incidents. However, in our material acute dissections represented 56% of aortic arch surgeries, while in Leipzig it amounted to 37% [10].

Thirty-day mortality was significantly higher in the emergency group compared to the elective group (33% vs. 15%, $p = 0.007$). Also, in other reports the perioperative mortality in aortic surgery remains high despite improvements in surgical and anaesthetic techniques, and it ranges from 25% to 30% [1, 16]. An important risk factor for this high early mortality is the preoperative status of the patients [17]. Chiappini et al. [18] demonstrated that pre-existing cardiac disease and pre-operative resuscitation are the leading predictors of hospital death. In our material 41% of the patients from the emergency group had cardiac tamponade before surgery, and almost half were operated on antiplatelet therapy. Furthermore, in the emergency group six patients had cardiac arrest before surgery; four of them (67%) died within the first 24 h after surgery.

CONCLUSIONS

The mode of the procedure had no effect on the choice of the operative methods of the aortic arch surgery. Early mortality in patients with dissection involving the aortic arch is still very high, while long-term mortality did not differ among the studied populations. Postoperative ARF requiring RRT is a critical predictor of mortality in both groups. The decision-making process for arch surgery should be based on the particular pathology, clinical condition, and relation between prognosis and surgical risk, which has to be assessed very objectively by the surgeon performing the surgery.

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Conflict of interest: *none declared*

References

1. Erbel R, Aboyans V, Boileau C et al. 2014 ESC Guidelines on the diagnosis and treatment of aortic diseases: document covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult. The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (ESC). Eur Heart J, 2014; 35: 2873–2926. doi: 10.1093/eurheartj/ehu281.
2. Cardiac Surgery in the Adult, Fourth Edition. The McGraw-Hill Companies, Inc. New York, 2012.
3. Hiratzka LF, Bakris GL, Beckman JA et al. Guidelines for the diagnosis and management of patients with thoracic aortic disease. Circulation, 2010; 121: e266–e369. doi: 10.1161/CIR.0b013e3181d4739e.
4. Bachet J, Guilmet D, Goudot B et al. Antegrade cerebral perfusion with cold blood: a 13-year experience. Ann Thorac Surg, 1999; 67: 1874–1878.
5. Kazui T, Inoue N, Yamada O, Komatsu S. Selective cerebral perfusion during operation for aneurysms of the aortic arch: a reassessment. Ann Thorac Surg, 1992; 53: 109–114.
6. Czerny M, König T, Reineke D et al. Total surgical aortic arch replacement as a safe strategy to treat complex multisegmental proximal thoracic aortic pathology. Interact Cardiovasc Thorac Surg, 2013; 17: 532–536. doi: 10.1093/icvts/ivt260.
7. Pierangeli A, Coli G, Donati A et al. Treatment of aortic arch aneurysms with deep hypothermia and circulatory arrest. J Cardiovasc Surg, 1975; 16: 409–414.
8. Ott DA, Frazier OH, Cooley DA. Resection of the aortic arch using deep hypothermia and temporary circulatory arrest. Circulation, 1978; 58: I227–I231.
9. Ueda Y, Miki S, Kusuhara K et al. Deep hypothermic systemic circulatory arrest and continuous retrograde cerebral perfusion for surgery of aortic arch aneurysm. Eur J Cardiothorac Surg, 1992; 6: 36–41.
10. Misfeld M, Leontyev S, Borger MA et al. What is the best strategy for brain protection in patients undergoing aortic arch surgery? A single center experience of 636 patients. Ann Thorac Surg, 2012; 93: 1502–1509. doi: 10.1016/j.athoracsur.2012.01.106.
11. Tsai TT, Trimarchi S, Nienaber CA. Acute aortic dissection: perspectives from the International Registry of Acute Aortic Dissection (IRAD). Eur J Vasc Endovasc Surg, 2009; 37: 149–159. doi: 10.1016/j.ejvs.2008.11.032.
12. Immer FF, Moser B, Krähenbühl ES et al. Arterial access through the right subclavian artery in surgery of the aortic arch improves neurologic outcome and mid-term quality of life. Ann Thorac Surg, 2008; 85: 1614–1618. doi: 10.1016/j.athoracsur.2007.11.027.
13. Patris V, Toufektzian L, Field M, Argiriou M. Is axillary superior to femoral artery cannulation for acute type A aortic dissection surgery? Interact Cardiovasc Thorac Surg, 2015; 21: 515–520. doi: 10.1093/icvts/ivv181.
14. Rylski B, Urbanski PP, Siepe M at al. Operative techniques in patients with type A dissection complicated by cerebral malperfusion. Eur J Cardiothorac Surg, 2014; 46: 156–166. doi: 10.1093/ejcts/ezu251.
15. Rylski B, Hoffmann I, Beyersdorf F et al. Multicenter prospective observational study. Acute aortic dissection type A: age-related management and outcomes reported in the German Registry for Acute Aortic Dissection Type A (GERAADA) of over 2000 patients. Ann Surg, 2014; 259: 598–604. doi: 10.1097/SLA.0b013e3182902cca.
16. Pape LA, Awais M, Woznicki EM et al. Presentation, diagnosis, and outcomes of acute aortic dissection: 17-year trends from the international registry of acute aortic dissection. J Am Coll Cardiol, 2015; 66: 350–358. doi: 10.1016/j.jacc.2015.05.029.
17. Rampoldi V, Trimarchi S, Eagle KA et al. Simple risk models to predict surgical mortality in acute type A aortic dissection: the International Registry of Acute Aortic Dissection score. Ann Thorac Surg, 2007; 83: 55–61.
18. Chiappini B, Schepens M, Tan E et al. Early and late outcomes of acute type A aortic dissection: analysis of risk factors in 487 consecutive patients. Eur Heart J, 2005; 26: 180–186.

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Doświadczenia jednego ośrodka w chirurgii ostrego rozwarstwienia aorty typu A i prawdziwych tętniaków łuku aorty

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Streszczenie

Wstęp: Chirurgia łuku aorty jest jednym z największych wyzwań kardiochirurgii.

Cel: Celem pracy była ocena czynników wpływających na wyniki chirurgicznego leczenia ostrego rozwarstwienia aorty i prawdziwych tętniaków łuku aorty.

Metody: W latach 2007–2014 operowano 172 kolejnych chorych z powodu patologii w obrębie łuku aorty. Wyróżniono dwie grupy: grupa I — 97 pacjentów operowanych z powodu ostrego rozwarstwienia aorty typu A wg Stanford, grupa II — 75 pacjentów operowanych z powodu prawdziwego tętniaka łuku aorty. Operację w zakresie łuku aorty zdefiniowano jako procedurę wymagającą wykonania okrężnego zespolenia na poziomie łuku aorty lub aorty zstępującej z wykorzystaniem technik ochrony ośrodkowego układu nerwowego, takich jak zatrzymanie krążenia w głębokiej hipotermii (DHCA) lub selektywnej perfuzji tętnic mózgowych (SACP) i/lub reimplantacji co najmniej jednej tętnicy dogłowowej.

Wyniki: W obu grupach dominowali mężczyźni (> 70%). Mężczyźni byli istotnie młodsi w grupie operacji w trybie nagłym (55 *vs.* 66 lat; $p < 0,008$). Ryzyko operacji oceniane w skali Logistic EuroSCORE było wyższe w grupie pacjentów operowanych w trybie nagłym (19,2% vs. 12,5%; $p < 0,001$). Przed operacją leki przeciwpłytkowe stosowało 49% pacjentów operowanych w trybie nagłym i 5% osób operowanych planowo ($p < 0,001$). Częściową wymianę łuku aorty wykonano u 79% (n = 77) pacjentów z grupy I (operacje nagłe) i u 76% (n = 57) choryh z grupy II (operacje planowe). Całkowitą wymianę łuku aorty wykonano u 19 (21%) osób z grupy I i u 18 (24%) chorych z grupy II. Najczęściej wykonywano osobną reimplantację poszczególnych tętnic dogłowowych — u 68% pacjentów operowanych w trybie nagłym i u 67% pacjentów operowanych planowo. Technikę *Elephant Trunk* (metodą klasyczną lub z wykorzystaniem stentgraftu) zastosowano u 53% (n = 10) chorych z grupy I i u 78% (n = 14) pacjentów z grupy II. Operacje oszczędzające zastawkę aortalną wykonano u 20% (n = 19) pacjentów operowanych nagle i u 9% (n = 7) osób operowanych planowo ($p = 0,063$). Zatrzymanie krążenia w głębokiej hipotermii zastosowano u 58% (n = 43) pacjentów operowanych planowo i u 39% (n = 37) chorych operowanych nagle. Selektywną perfuzję tętnic mózgowych wykonano u 61% (n = 58) osób operowanych nagle i u 42% (n = 31) chorych operowanych planowo. Śmiertelność szpitalna w grupie pacjentów operowanych w trybie nagłym wyniosła 33% (n = 32), a w grupie operacji planowych — 15% (n = 11; $p = 0,007$). W modelu wieloczynnikowej regresji logistycznej czynnikami istotnie wpływającymi na śmiertelność były: w grupie pacjentów operowanych nagle — Logistic EuroSCORE > 19,5%, czas krążenia pozaustrojowego > 228 min, pooperacyjna ostra niewydolność nerek. W grupie chorych operowanych planowo do czynników, które istotnie wpłynęły na śmiertelność, należały: czas zatrzymania krążenia w głębokiej hipotermii > 26 min, pooperacyjna retorakotomia z powodu krwawienia i pooperacyjna ostra niewydolność nerek. Informacje dotyczące pooperacyjnego stanu klinicznego (*follow-up*) uzyskano o wszystkich pacjentach. Średni czas obserwacji w grupie osób operowanych nagle wyniósł 24,3 ± 27,10 (min. 0, maks. 92) miesięcy, a w grupie pacjentów operowanych planowo — 30,3 ± 24,5 (min. 0, maks. 99) miesięcy. W okresie obserwacji całkowita śmiertelność w grupie chorych operowanych nagle wyniosła 43% (n = 42/97), a w grupie operacji planowych — 36% (n = 27/75).

Wnioski: Śmiertelność szpitalna w grupie pacjentów operowanych w trybie nagłym była wyższa, natomiast nie zaobserwowano różnic między grupami w zakresie śmiertelności odległej. Pooperacyjna ostra niewydolność nerek była najbardziej istotnym czynnikiem ryzyka zgonu w obu badanych grupach.

Słowa kluczowe: tętniak aorty, chirurgia łuku aorty, ostre rozwarstwienie aorty, protekcja ośrodkowego układu nerwowego

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